ENGINEERED PRODUCTIVITY SOLUTIONS

Turbocharger machining

25% faster than with conventional machining
A SUCCESSFUL COLLABORATION
THE TURNKEY SOLUTION FOR MACHINING NEW GENERATIONS OF TURBOCHARGERS

Productivity PLUS! A highly efficient solution in turbocharger manufacturing from STAMA Maschinenfabrik GmbH and KOMET GROUP GmbH

A time saving of up to 67%.
Machining time reduced by up to 25%.

The combination of the STAMA MT 838 TWIN milling-turning centre and KOMET® machining optimisation with a special KomTronic® U-axis tool is setting new standards. A time saving of up to 67% is achieved for V-belt machining alone. This is mainly the result of interpolation grooving and turning, which replaces the circular milling process which was originally used, and the result of the use of KOMET® U-axis systems.

The result: The time required for the entire machining process for the component is reduced by 25%. In addition to drastically reduced tool costs.

Requirements for turbocharger manufacturing:

Relating to the material
- Extremely high requirements relating to thermomechanical properties, high heat resistance – use in temperatures of up to 1100 °C for petrol engines
- Use of high-alloy, high-temperature-resistant materials with a high nickel and chrome content
- Extremely low thermal conductivity (Heat is directed into the machining tool)
- Strong tendency towards strain hardening
- Highly abrasive cast skin, edge zone hardness up to 450 HV 0.5
- Austenitic matrix with chromium carbides requires high cutting forces, which result in a relatively short tool life
- In short, abrasive and difficult to cut

Relating to machining
- High requirements relating to form and position tolerances
- Automated series production
- Reduction of costs per piece and the machining time

Benefits for you:
- Significant reduction in machining process by 25%
- Increase in ultra-precise machining
- Tool life increased by several degrees
- Fewer tools required
- Integrated assistance and monitoring system
- A high degree of automation designed for series production
- Increase in long-term quality of turbochargers

Turbocharger housing
INNOVATIVE SOLUTIONS FOR TURBOCHARGER MANUFACTURING

The solution on the machine side
- Double-spindle STAMA milling-turning centre MT 838 TWIN with HSK-A100
- Highly dynamic and stable complete machining with milling and turning
- Complete freedom in the choice and sequence of options

Machining strategy
- Rotationally symmetrical machining with highly asymmetric component
- Use of freely programmable KOMET KomTronic® U-axis systems enables any type of contour machining and turning on parts which are not rotationally symmetrical. Through the combined use of customised snap-on tools and optimally selected indexable inserts
- Machining contours in bores as well as internal and external machining results in a significant reduction in production times, better surface quality, and improved dimensional accuracy
- Fewer tools required
- Use of 3D-printed special tools with innovative coolant channels adapted to the process

Productivity PLUS! KOMET® tool solutions

Examples of ultra-precise machining

KOMET® arbor face-milling cutter for machining of turbo chargers Ø 50 – 125 mm
With double-sided octagonal indexable inserts with 16 usable cutting edges.

Benefits for you:
- Robust design, stable and secure position in the basic body
- Special cutting material suitable for the toughest thermomechanical requirements
- Defined, stable cutting edge guidance
- Maximum productivity, process reliability and cost-efficiency guaranteed

Finish machining of V-belt outer diameter – KOMET KomTronic® U-axis systems
With 3D-printed snap-on tool and indexable inserts in special designs, with three cutting edges with ground recess geometry and flute.

Benefits for you:
- Considerably higher cutting values than with conventional machining
- Integrated position measuring system
- Short, stable tool design thanks to optimal compact connection

Pre-machining of V-belt outer diameter – KOMET® interpolation grooving and turning tool

Benefits for you:
- Extremely stable tool design
- Special adaptation of the cutting edge geometry to the machining process with regard to machining time and stability
- Internal coolant supply directly to the tool’s cutting edge

Finish machining of counter bearing conical hole – KOMET KomTronic® U-axis systems
With stepped snap-on tool with four indexable inserts.

Benefits for you:
- Complete finish machining with a single tool
- Enables maximum precision to be achieved
- 99% use of standard indexable inserts
- Direct coolant supply to the individual cutting edges
- Integrated position measuring system
- Short, stable tool design thanks to optimal compact connection
OPTIMISATION OF THE MACHINING PROCESS

Selected machining examples – Conventional machining vs. KOMET® strategy

Process: Pre-machining of V-belt outer diameter

**Previously** Conventional roughing with two tools
- First step: Pre-machining with special boring bar
- Second step: Pre-machining with special circular milling cutter 100

**Now** Complete manufacturing with KOMET® interpolation grooving and turning tool

**Advantages**
- Time reduction of up to 47%
- Circular milling 75 sec – reduction to below 40 sec with interpolation grooving and turning
- High level of process reliability
- Reduces number of tools required by one, eliminating the need for changeover time

Process: Finish machining of V-belt outer diameter

**Previously** Conventional finish machining with interpolation grooving and turning tool

Machining process is heavily dependent on the machine performance (cutting speed, feed rate, etc.)

**Now** KOMET KomTronic® U-axis systems with direct position measuring system and 3D-printed snap-on tool

**Advantages**
- Significantly higher cutting speeds can be achieved
- Considerable reduction in machining times
- Rapid amortisation
**Process: Finish machining of counter bearing conical hole**

**Previously** Conventional counter bearing machining with up to four tools
- First step: Semi finish liner
- Second step: Semi finish bearing ring
- Third step: Semi finish counter bearing
- Fourth step: Semi finish liner

**Now** KOMET KomTronic® U-axis systems with stepped snap-on tool and direct position measuring system

**Advantages**
- Complete finish machining
- Increased positioning accuracy and process reliability
- Freely programmable U-axis enables use of standard cutting edges for complicated contours.

**Effect:** Lower cutting pressure and machining of the contour line in a single operation

**Result:** Lower machining forces, longer tool life and extremely long shape retention as a result

**HSK-A100 Mono special boring bar**

**HSK-100 Mono special boring bar**

**HSK-A100 Mono special boring bar (adjustable)**

**Finish machining of V-belt with KomTronic® U-axis tool**

**Watch now!**
www.kometgroup.com/turbocharger

You can also find all KOMET® videos on our YouTube channel:
www.youtube.com/kometgroup
TURBOCHARGER MANUFACTURING

Independent study by Reutlingen University, Prof. Dr.-Ing. Helmut Nebeling verifies the cost-effectiveness of the innovative turbocharger manufacturing process.

Example: Reduction in time required for "V-belt" finishing

<table>
<thead>
<tr>
<th>Method</th>
<th>Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpolation milling</td>
<td>174</td>
</tr>
<tr>
<td>U-axis</td>
<td>30</td>
</tr>
</tbody>
</table>

Cutting values achieved for "Trumpet"

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_c$</td>
<td>140 m/min</td>
</tr>
<tr>
<td>$f$</td>
<td>0.12 mm/rev</td>
</tr>
<tr>
<td>$a_p$</td>
<td>0.3</td>
</tr>
<tr>
<td>Form tolerance</td>
<td>&lt; 0.020 mm</td>
</tr>
<tr>
<td>$R_z$</td>
<td>&lt; 16 m</td>
</tr>
</tbody>
</table>

U-axis enables efficient, quicker and more cost-effective machining of turbocharger housings.

<table>
<thead>
<tr>
<th>Costs per part</th>
<th>Conventional</th>
<th>U-axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery costs</td>
<td>12.53</td>
<td>12.18</td>
</tr>
<tr>
<td>Tool costs</td>
<td>19.87</td>
<td>0.40</td>
</tr>
<tr>
<td>Labour costs</td>
<td>10.05</td>
<td>6.03</td>
</tr>
<tr>
<td>Total costs</td>
<td>51.44</td>
<td>18.61</td>
</tr>
</tbody>
</table>
COST BREAKDOWN USING CUTVIEW® PLANNING SOFTWARE

In the early planning stage for turbocharger machining, the basis for the machining times and cost analysis is formed using the CutView® planning tool. The KOMET GROUP tool equipment in conjunction with the STAMA MT 838 TWIN milling-turning centre provides the basis for this machining example.

With regard to this project, CutView® is characterised by the following features:

- Quick and easy operation of machining processes, tools and machines
- Ease of use and smooth data exchange based on Microsoft Excel
- Determines how long a workpiece runs on a machine
- Time calculation for adjusting the machining sequence
- Tool calculation with costs involved
- Calculation of torque, cutting performance, feed power and primary processing time
- Material database and cutting values database with empirical values
- Evaluation of: Calculation of service life analysis for tools, CPP (cost per part) saving, amortisation, tool comparisons and planning

More information can be found at www.thomann.com/en

KOMET® BRINKHAUS TOOLSCOPE ASSISTANCE SYSTEM IN USE FOR TURBOCHARGER MACHINING

Machining processes for turbochargers place new demands on processes and machines in terms of quality assurance. With the ToolScope assistance system, KOMET® fully satisfies these demands as well.

With ToolScope, the KOMET GROUP is the only tool manufacturer to offer a true Industry 4.0 solution, even for small and medium-sized companies. Turbocharger machining processes enable the full potential of this system to come into play.

ToolScopes record and document the machine’s internal data during the machining process, such as the torque of a spindle or name of the current programme. ToolScope apps can use this data to monitor the process in real time or optimise the feed override during the process. ToolScope can be used to document monitoring results and automatically transfer this documentation to the customer server for archiving. KOMET® offers additional software for optimising data storage.

Benefits for you:

- Reduced cycle time for face milling
- Fingerprinting of processes prior to the start of series production
- Automated average process monitoring
- Reduced tool costs thanks to wear-dependent tool change
- Automated monitoring of the machine status
- Documentation of in-process measured values with automated connection to customer IT systems

1. Monitoring processes are clearly displayed.
2. Clear displays (piece counter here) facilitate the understanding of processes in the machine.
3. ToolScope data can be quickly visualised. KOMET® even offers Excel templates to help you reach your goal faster.
FAQ – questions and answers regarding KOMET® U-axis tools

1. What levels of accuracy can be achieved with the KomTronic® U-axis?
Diameter of 0.02 mm with no measuring system on the slide, diameter of 0.005 mm with a measuring system. The measuring system can perform analysis with a measuring accuracy of 0.0001 mm (accuracy is dependent on other machining factors, such as tool change errors, wear on the cutting edge, etc.)

2. How can the position of the inserts be corrected?
On the tool via short clamp holders or for each cutting edge directly via the tool management.

3. Does the U-axis always need to be re-measured each time the inserts are changed?
No, the U-axis or slide is always in the same position. The insert position can be corrected directly in the machine via an in-process measurement.

4. Does the KomTronic® U-axis need to be removed from the machine in order to measure the tool?
No, this is conveniently carried out by integrating an attachment point connection (optional).

5. What is the maximum speed limit?
With the single slide balanced in the central position, the maximum speed is 4000 rpm, adjusted depending on the stroke. At up to 8000 rpm over the entire axis stroke (see the "KomTronic® drawbar tools for machining centres" brochure).

6. Can the KomTronic® U-axis also be used for roughing?
A variety of machining processes can be used (finishing and roughing). The slide has a maximum power of 4000 N and a permissible torque of 200 Nm. However, the possible usage data depends on the overall length of the tool and the U-axis.

7. How is the U-axis driven?
The U-axis is driven via a servo motor. The slides for the UAS115/160 series are driven via a roller thread drive with no play.

8. What workpiece diameters can be machined?
The range of application is 0.5 – 500 mm, taking into consideration the relevant projection length and attachment point.

9. What is the maximum possible number of different diameters or cutting edges?
Any number of cutting edges are possible. This is dependent on the tool length and tool width (slide) of 40 or 60 mm respectively, and the control system.

10. How is the tool system set?
The U-axis is always changed in the central position. This enables the snap-on tool to be measured on a dummy in the presetting device. In addition, post-process measurement with automated cutting edge correction is possible via the tool management.

11. What are the maintenance and service intervals?
Recommended once a year, or every two years depending on use.

12. How long is the expected service life?
With regular maintenance and care and the replacement of wear parts, a service life of >6500 operating hours is realistic, corresponding to approximately 10 years.

13. How accurate is the system for double-spindle machining?
Both systems should be used offset (180°) depending on the imbalance. As with a single-spindle machine, with the double-spindle machine the accuracies in point 1 are achieved with exact tool presetting or a Z-axis that can be adjusted/corrected separately.

14. What is the maximum size that can be machined with HSK63 or HSK100?
KomTronic® UAS-115: Up to dia. approx. 250 mm
KomTronic® UAS-160: Up to dia. approx. 500 mm taking into consideration the relevant projection length and attachment point.

15. Are the U-axes more suitable for vertical machining than horizontal machining?
U-axes are used both vertically and horizontally. The advantages and disadvantages here should be considered to be the same as for a mechanical tool (centrifugal forces).